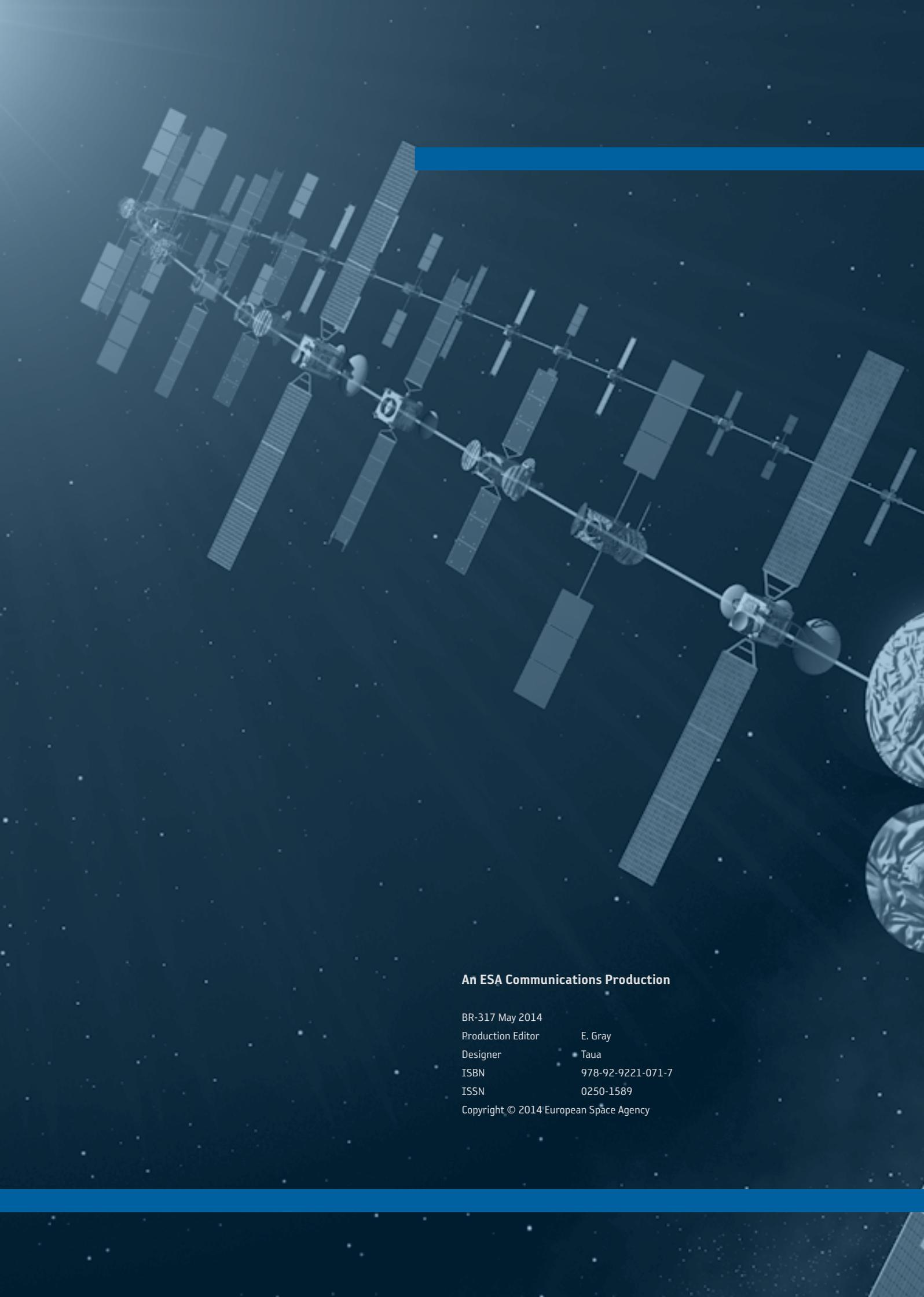


# → ARTES COMPETITIVENESS

Strengthening the position of Europe and Canada  
in the global satcom market



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# Introduction ■

Close to 400 million households worldwide receive television programmes directly from geostationary satellites. Of these, about 40% are in emerging countries. In Europe alone, 80 million households receive information and entertainment directly via satellite TV, while cable TV is fed by satellite for another 66 million households.

Satellite broadband, as the only way able to connect users, immediately and cost-effectively, no matter where they are located – mountains, islands, remote or sparsely populated areas – was the key to helping the European Commission achieve its 2013 Digital Agenda for Europe target of 100% coverage with basic broadband.

The number of households worldwide adopting satellite TV is growing at a staggering rate. For example, between 2008 and 2011, almost 100 million households worldwide took up satellite TV. This is greater than the total number of households in France, Germany and the United Kingdom combined. By comparison, cable TV and TV-over-Internet gained 55.5 million and 26.4 million, respectively in the same period.

In parallel with the growth in the consumer market, governments are also relying more than ever on satellite communications to support government operations, intelligence gathering, welfare services, peace keeping and disaster recovery operations.

In short, the satcom sector affects our societies and everyday lives in a myriad of ways.

Europe's satcom manufacturing industry has been generating strong revenues and high-quality employment opportunities, thanks to a reputation for quality solutions and its flexibility in adapting to customer needs. During the period 2010–12, it secured orders worth about €9 billion.

However, Europe's share of the satellite manufacturing market has been eroding over the last few years, particularly for satellites requiring advanced technologies. The reasons for this are multiple. Mainly this is due to a more aggressive positioning by US industry taking advantage of new technologies often developed within governmental programmes, along with creative commercial and financial offers, leveraging access to the large market for US governmental telecom services. This allows, in some cases, US manufacturers to offer more favourable terms to their commercial

customers. New competitors, with strong state backing are also emerging, such as China and Japan.

The situation in the ground segment is even more difficult, where the dominant players (mainly from the US) are vertically integrated while enjoying economies of scale, thereby limiting access for European and Canadian companies.

The challenges faced by European and Canadian space industry are therefore formidable. To meet them, industry will need to sustain continuous innovation in order to offer creative and competitive solutions for the rapidly evolving market.

An increased budgetary effort is necessary to sustain continuous technology research and product development along with the necessary highly skilled workforce and high-tech facilities. This level of steady innovation carries with it risks and requires continuous investment, which industry alone cannot shoulder.

There is, therefore, an important role for ESA to play in supporting member-state industry in facing these challenges. ESA's ARTES competitiveness programme is critical in supporting and strengthening the European and Canadian space industry in the global market.

ARTES has a number of instruments to support industry, with funding levels commensurate with the maturity of the technology, and the proximity of products to the market. These elements include:

- ARTES 1 supports the early stages of the innovation cycle, laying the foundations for subsequent technology, product, system and service developments.
- ARTES 5.1 supports longer-term technology development.
- ARTES 5.2 and ARTES 3–4 are targeted at short- and mid-term competitiveness of the industry, with the goal of developing commercial products in a cost-sharing approach.
- ARTES 3–4 also supports the design, development and demonstration of telecommunications applications, leading to fully operational, self-sustaining services.
- ARTES 33 provides a framework for bringing innovative products, systems and services to the market in partnership with operators and users.

These ARTES elements work together as an integrated and unified process to provide an effective and efficient mechanism to support industry in its efforts to introduce innovative products and services to the market in a timely manner.

In the following pages you will find a selection of technology and commercial success stories achieved by European and Canadian industry thanks to the ARTES competitiveness programme lines. Some of these stories clearly demonstrate how new products can be decisive for winning orders for complete telecom satellite systems. Large numbers of innovative technologies and products have been carried on ESA public-private partnership satellites, leading to recurring sales. ESA, together with the Member States, needs to ensure more of these success stories in order to maintain the competitiveness of European and Canadian space industry in the global satcom market.

*Magali Vaissiere  
Director of Telecommunications and Integrated Applications*



**In recent years the UK Government has made a strong commitment to growing a world-class space industry, as witnessed by the partnership with industry in developing the UK Space Innovation and Growth Strategy. The ESA ARTES programme supports the development of innovative and advanced telecommunications satellite and payload technology within Airbus Defence and Space UK, and is a great enabler towards securing major private investment in advanced telecommunications satellite programmes that bring jobs and growth to the UK.**

**Colin Paynter**  
*UK Managing Director*  
*Airbus Defence and Space*



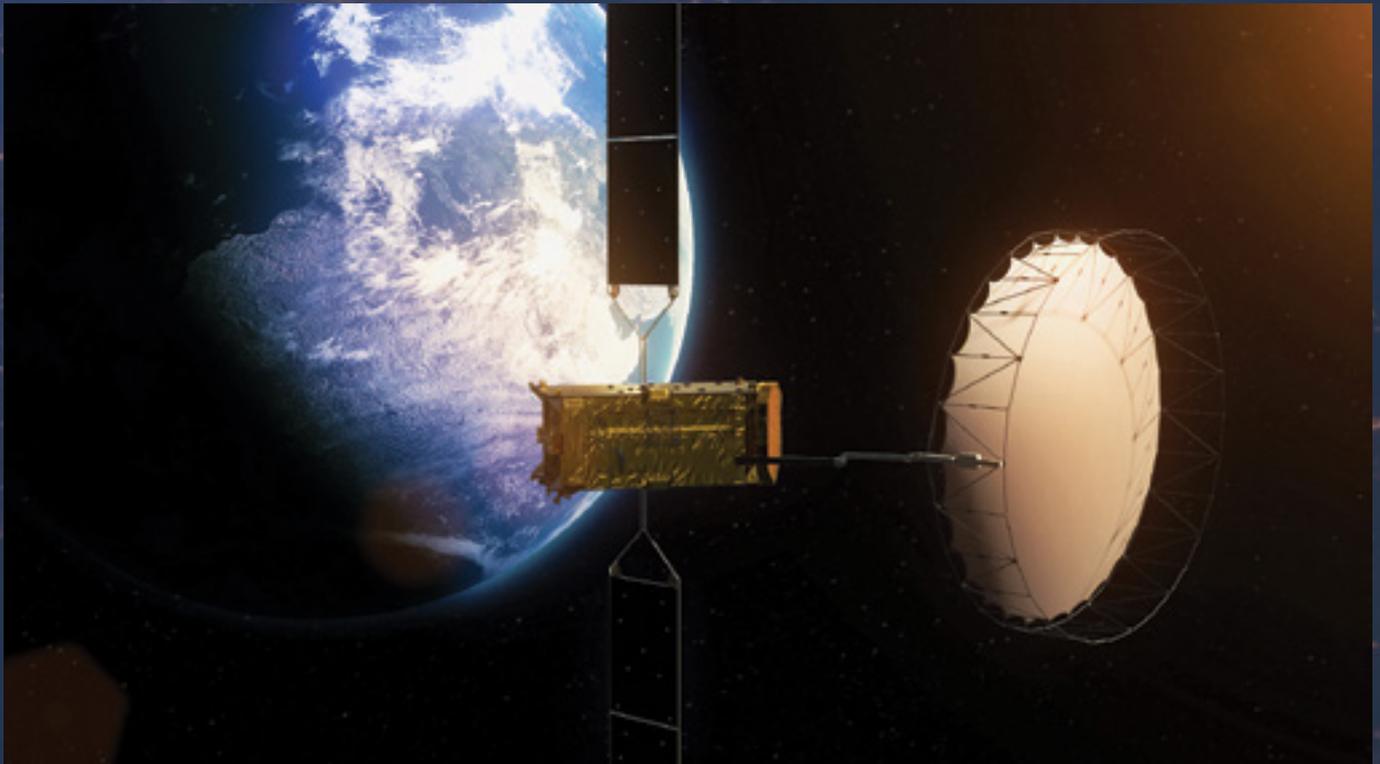
## → ALPHASAT: A FOUNDATION FOR CONTINUED COMMERCIAL SUCCESS

ESA/Inmarsat

Following its launch in July 2013, Alphasat has not only been successful as a project in its own right, but it is also serving as a vehicle to improve the

competitiveness of contributing states' space industries. It was engineered and built by Airbus Defence and Space (formerly Astrium) through a public-private partnership

between ESA and Inmarsat. Alphasat has also enabled the flight demonstration of a variety of new and advanced satellite technologies, including those highlighted below.

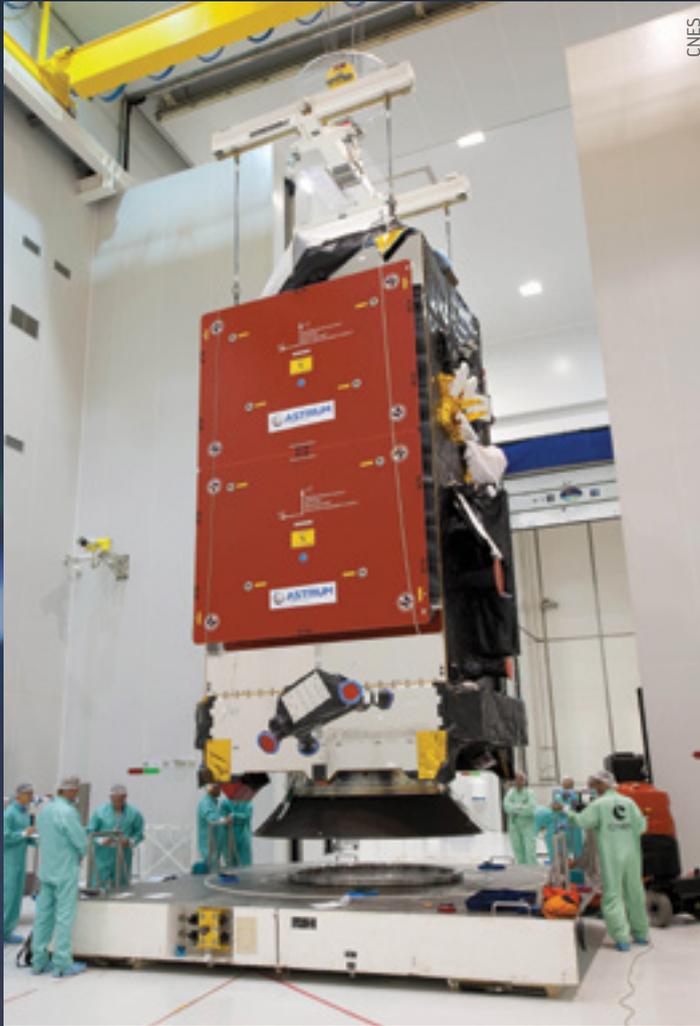


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**ARTES 8 and Alphasat have been of utmost importance for Airbus Defence and Space to foster innovation and introduce leading edge products to increase our position as market leader in geostationary comsats.**

Arnaud de Rosnay  
*Head of Telecommunications Satellites  
Airbus Defence and Space*

”



CNES

## → GUIDING STARS

Selex-ES  
Italy

The Active Pixel Sensor startracker delivers a robust and accurate three-axis attitude determination with very low mass and power consumption for the class of instrument.

Thanks to the flight heritage, as part of the Alphasat attitude and orbit control system, the new unit is now included in the Selex-ES star sensor catalogue. It has received more than 300 flight unit orders, including export sales for a commercial telecom constellation contract where Selex-ES has delivered flight units derived from Alphasat.

## → POWER DISTRIBUTION

Airbus Defence and Space  
France

Another important spin-off is Alphabus's 100 V power supply regulator, designed and manufactured by Airbus Defence and Space. This technology supplies the primary power system for Alphabus, increasing its efficiency compared to

previous systems. This unit has matured into a key component of Airbus's proven and robust satellite platform, the Eurostar E3000, which landed its first contract in 2013 for the Russian Express-AMU1 satellite.



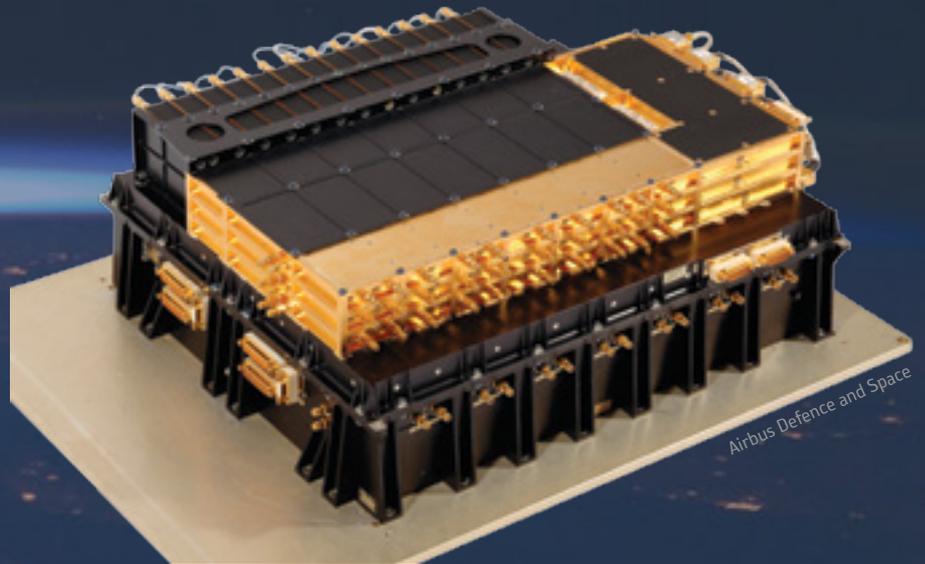
Airbus Defence and Space

## → DIGITAL SIGNAL PROCESSING

Airbus Defence and Space  
UK

The integrated digital processor is the heart of the Inmarsat payload on Alphasat, providing channel routing and beam-forming functions. The unit is the second generation of this product line to be developed with the assistance of ARTES 3-4. It is now being considered for a number of other flight opportunities.

Through Alphasat, and the support of ARTES, Airbus Defence and Space has developed new products for the highly competitive processed and flexible payloads market for telecom satellites, establishing their reputation as a world leader in this technology.



## → ADVANCED ASTRO APS STARTRACKER

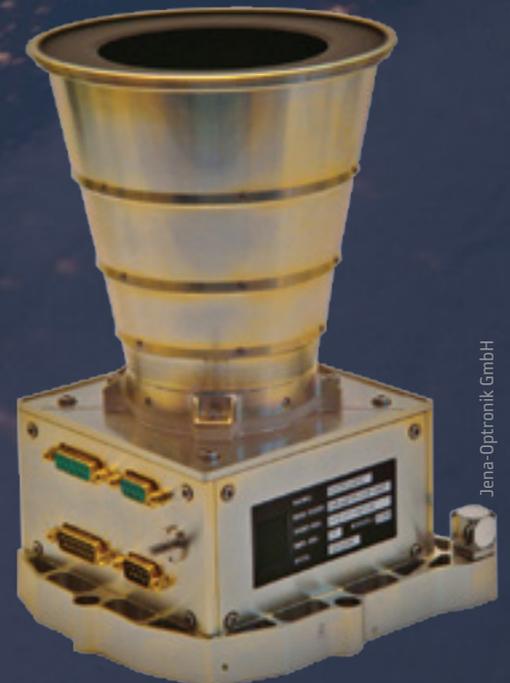
Jena-Optronik GmbH  
Germany

Alphasat was also the first opportunity for Jena-Optronik to qualify and fly an Active Pixel Sensor (APS) for accurate and autonomous attitude acquisition. A leading global supplier of state-of-the-art attitude and orbit control system sensors, which have extensive in-orbit heritage, the German company

developed Astro APS, a small, flexible, robust and high-precision startracker. The unit also works in tandem with the optical communication terminal. Thanks to the Alphasat mission, Jena has received orders for more than 50 such startrackers, with more than 30 of them from outside Europe.

“ With this premiere in space we successfully demonstrated the in-orbit performance of Astro APS. The sensor is working precisely and delivering accurate measurements. The key to unlocking this market has been the qualification achieved with Alphasat and the associated in-orbit validation.

Dr Axel Kwiatkowski  
Product Manager, Jena-Optronik GmbH



## → LAYING THE GROUNDWORK FOR NEW FREQUENCIES

Thales Alenia Space  
Italy

Alphasat was the first civil Q/V-band telecommunication system demonstration. It is a pioneer opportunity to open up previously untapped frequencies to satisfy digital consumers' growing hunger for bandwidth.

To support this hosted payload, Thales Alenia developed a new generation of Q-band low-noise amplifiers and receivers. Since the Alphasat launch, these units have been supplied to other customers for deployment in launches in 2013 and 2014.

**We are consolidating our knowledge and expertise in the Q/V-band frequencies. This development places Italian industry at the forefront of the new opportunities offered by this frequency range, using more compact hardware than Ka-band.**

Alberto Pandolfi  
TAS-Italy



Thales Alenia Space Italia

## → USING SATELLITE STRUCTURES TO STRENGTHEN EUROPEAN INTEGRATION

Thales Alenia Space  
Italy

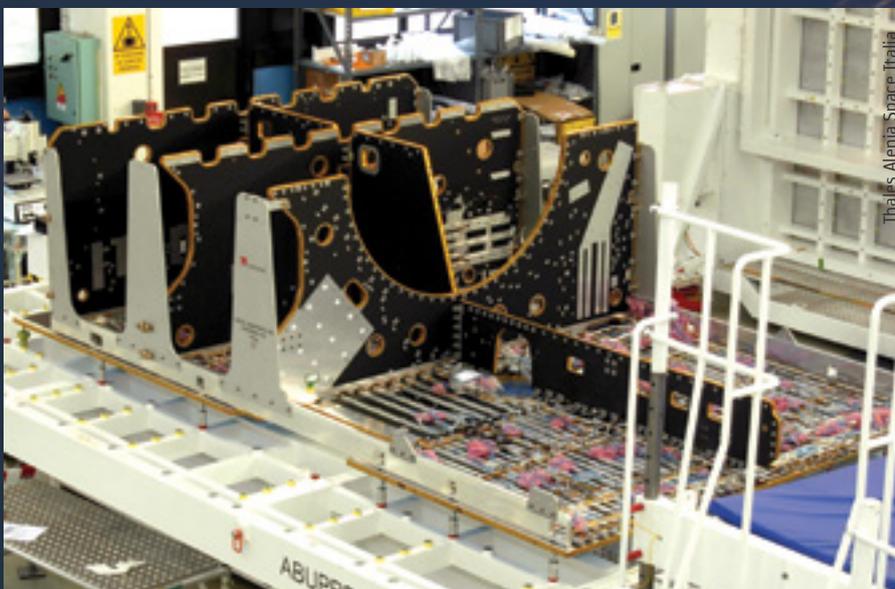
Another achievement of the Alphasat programme has been the diversification of suppliers of space technology within Europe. By taking part in the Alphasat programme,

TAS-Italy was able to develop their range of services to include supplying panels and structures for the TAS group, complementing the core team in France.

To achieve this, TAS-Italy, based in Turin, took on the manufacturing, assembly and delivery of the Alphasat Repeater Module, which provides a home for the satellite's payload.

Based on the experience and new skills acquired for Alphasat, the Turin team has achieved greater commercial success by delivering panels and structures for a number of other programmes, including O3b, Athena-Fidus, Sicral-2, W3D, Gokturk, Turksat-TKM, 8WB and Iridium.

These success stories illustrate how Alphasat and the ARTES programmes provide essential support to the European telecom satellite industry. As a result, European businesses are reaping the benefits of advanced technology developments, generating new skills and products, and enjoying commercial success worldwide.



Thales Alenia Space Italia

## → ULTRA-HD TV: THE NEXT CHALLENGE IN SATELLITE BROADCASTING

Newtec  
Belgium

Information is now processed, transmitted and delivered to a growing number of end-users with more accuracy and speed than ever before. As a result, the demand for data delivered by satellites is growing exponentially.

During the 2012 London Summer Olympics and the 2014 Sochi Winter Olympics, for example, broadcasters were obliged to provide vast amounts of content, often occurring simultaneously, and distribute it to a global audience. This was all done by satellite.

For the telecom business, it has become a necessity to keep pace with these fast-moving developments. For hardware to keep up with rising needs and expectations, it must continue to evolve.

Newtec, a well-established ESA partner, recently broke a world record in transmission speeds with its MDM6000 satellite modem, delivering a staggering 506 Mbit/s

through a 72 MHz transponder, thereby establishing a new level in efficient use of the crowded radio spectrum. The tests were completed under fully operational conditions, setting the stage for Newtec to provide products to deliver the next generation of TV services, including 4k HDTV, Ultra HDTV, stereoscopic and multi-view 3DTV.

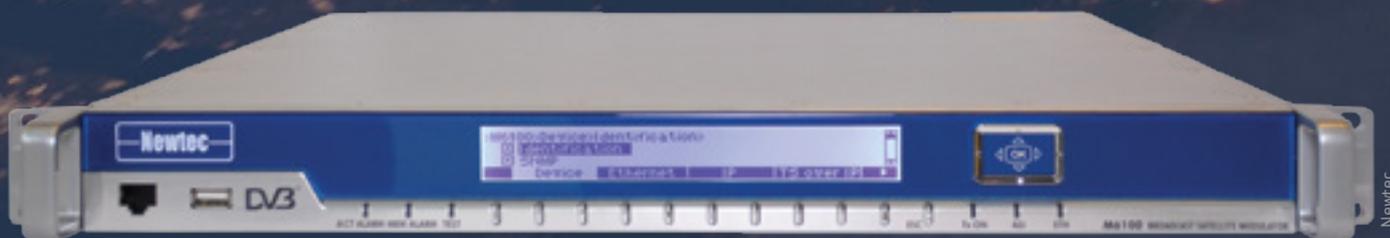
Newtec's M6100 Broadcast Satellite Modulator collected the 2013 Teleport Technology Award for Excellence in Washington DC, USA, in recognition of its innovative direct-to-home technology. The M6100 earned the accolade by providing more efficient and adaptable ways of processing signals for digital TV broadcasting via satellite than any of its predecessors, while at a lower cost.

Newtec's latest generation of modulators makes use of knowledge and equipment that was not available five years ago, but calculated and forward-thinking investment have now made this breakthrough in

performance possible. It not only increases reliability and expands bandwidth usage, but also reflects the ever-evolving nature of the telecom business by being 'future proof' – a platform with technology for systems that have yet to be built.

The M6100 and MDM6000 new products have put Newtec in a leadership position in the telecom and TV markets. The newly launched Newtec Dialog platform, combining the best of SCPC and MF-TDMA technologies in one system, will also benefit from the performance of the M6100 technology.

ESA co-funded the Newtec MDM6000 and M6100 via its ARTES 3-4 programme. ARTES 3-4 makes it possible for European companies to invest in cutting-edge technology that pushes the limits of telecommunications. Thanks to support from ESA, Newtec has grown from humble beginnings in 1985 to become a worldwide player in the satcom market.



**The new products M6100 and MDM6000 have put Newtec into a leadership position in the broadcast and telecom markets. ESA's funding and technical support has been instrumental to this success!**

Serge Van Herck  
CEO, Newtec

Newtec

## → COMMERCIAL SUCCESS FOR SATELLITE COMMAND RECEIVERS AND TRANSMITTERS

Com Dev International  
UK

Com Dev's S-band telemetry, tracking and control (TT&C) transponder has proved to be a great commercial success for the global designer and manufacturer of space hardware, with a C\$4 million contract and options for further sales secured.

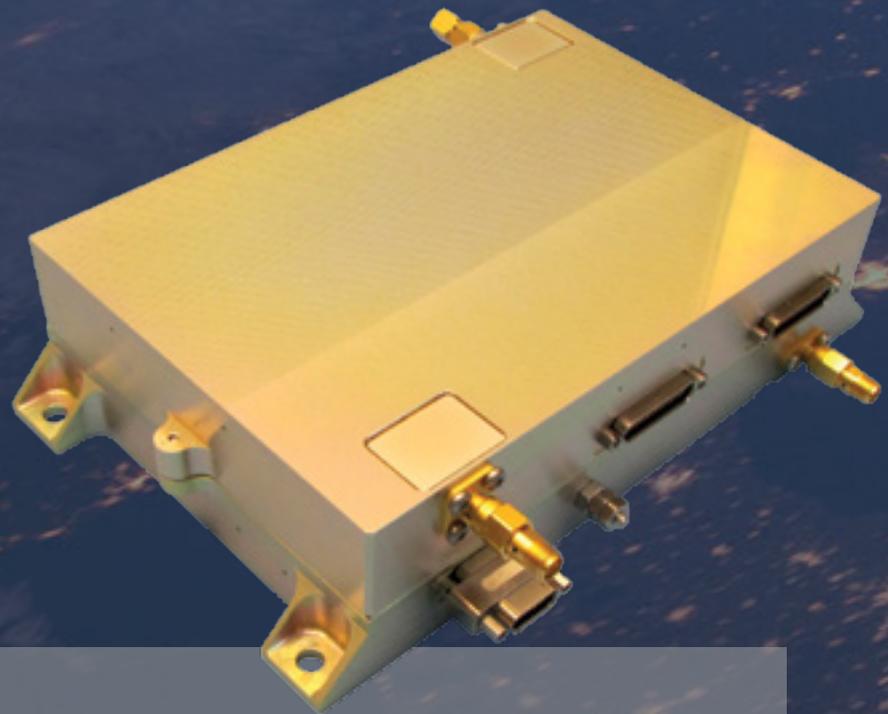
The transponder, developed and qualified under ARTES 3-4, incorporates command receivers and telemetry transmitters, which together provide the vital link between the ground controllers and a satellite. These vital components are required by all satellites to pilot the satellite in orbit.

The S-band TT&C transponder combines the latest gallium nitride power amplifier technology with flexible Software Defined Radio technology. The transponder's efficient and flexible design enables

it to be reused for different types of mission, enhancing its sales potential for the future.

A contract to supply 14 of these transmitters was awarded to Com Dev International in October 2013, with an option for a further 12 units. They are to be deployed on the first six Formosat-7 satellites being developed by Surrey Satellite Technologies Ltd to support global weather forecasting.

Formosat-7 will be the third mission using Com Dev's TT&C equipment, following exactView-1 and the M3M satellite. The order will be fulfilled over two years through Com Dev's facility in Aylesbury, UK, securing high-value employment for the European space sector.



Com Dev International

“

**The ARTES 3-4 support in the development of our innovative new TT&C product was an essential element of its successful early adoption for the Formosat-7 programme. The advice provided by the ESA staff during its design and validation ensured a robust but cost-competitive product was developed which we are confident will lead to further orders around the world.**

Rob Goldsmith  
*Business Development Director  
Com Dev International Systems Division*

”



“

We are pleased with the opportunity to work closely with ESA on development of these exciting high-throughput VSAT products and find customers are astounded at the performance and efficiency they deliver.

”

Bjorn Platou  
Senior Vice President  
EMC Satcom Technologies (formerly STM Norway)

## → SATELLITE BROADBAND SPEEDS: FASTER THAN EVER

STM  
Norway

The steadily growing global market for satcom services is obliging European space industry to look for more efficient ways of using the available frequencies. This is driving a new generation of satcom modems, and the ARTES programme is supporting these developments.

New techniques developed in various ARTES projects have achieved improved bandwidth efficiency, with particularly large gains in outbound links: up to 250% over the previous generation. This should result in impressive savings in bandwidth costs for satcom customers.

As part of ARTES 3–4, STM Norway developed a satellite broadband gateway and a range of Very Small Aperture Terminal modems that provide a low-cost answer for highly dynamic, demand-driven transmission capacity for residential, commercial and institutional users.

Depending on satellite link budgets and other system design parameters, the modems can provide dynamically in excess of 150 Mbit/s to each terminal on the outbound link, and up to 24 Mbit/s on the inbound link, well in excess of terrestrial ADSL or cable connections. This is significantly faster than offered by previous satellite services.

This technology is currently deployed for 30 satcom services worldwide. Many technical features of these new modems are directly derived from past ARTES projects, including higher-order modulations, advanced forward error correction schemes, adaptive coding and modulation on both inbound and outbound links, Internet Protocol-friendly link layer encapsulation, and efficient framing of data.

## → NEW MARKET OPPORTUNITY BECOMES COMMERCIAL SUCCESS

Thales Alenia Space  
France

In the fiercely competitive telecom satellite microwave products sector, Thales Alenia Space identified a gap in the market for two new products. These products have become a commercial success with the support of ARTES.

Firstly, Thales Alenia Space identified a need for a new receiver to address the growing interest in the 25/17 GHz band, or reverse direct broadcast satellite band, for multimedia broadband services over North and South America. Two versions of a Ka-band 25/17 GHz telecom receiver were developed during the project.

Secondly, a Ka-band 30/20 GHz dual down-converter was developed to provide an alternative to a typical standalone converter, providing significant reductions in mass, footprint, power consumption and cost for today's large payloads.

Following testing, the new frequency converters are already in use. More than 60 of the Ka-band 25/17 GHz receivers are either in production or

have been supplied for use. The unit has been deployed on three different platforms, including Athena–Fidus.

More than 20 units of the Ka-band 30/20 GHz dual down-converter are in production or have been supplied to customers. Sales are forecast to quadruple over the next three years.



“

**Thales Alenia Space strongly supports the co-funded activities of ARTES 3–4 & 5. These allow the group to offer fully developed and innovative equipment for new satellites. In particular, we welcome the new Atlas line, which facilitates the development of new-generation satcom technologies and increases the likelihood of their adoption by commercial customers. Furthermore, we hope that these activities will be strengthened and enlarged to ensure the development of new initiatives, at both the equipment and system levels.**

Bertrand Maureau  
*Vice President Business Line Telecommunications*

”

## → EASY ACCESS TO SATELLITE TV IN THE HOME

Global Invacom  
UK

Satellite television has become a fixture of modern life, but viewers do not want to be constrained by viewing just a small number of channels on conventional TV sets. They want to be able to watch TV on different devices at various locations around their homes.

Thanks to Global Invacom and ESA, the day is approaching when we will be able to view satellite TV programmes on any networked device in our homes, be it a smartphone, tablet, television or computer. The new technology converts the

broadcast signals from satellites into standard Internet data based on SES-Astra's SAT-to-IP protocol, which was developed with support from ARTES.

The demonstration system makes it possible to stream up to six different television programmes simultaneously. It can be configured for 32 end-users for a total of 192 channels.

The system's ability to provide multiple channels in one building means it is particularly suitable for multidweller units where residents wish to access

many different channels on various devices at the same time. This would be possible without requiring separate satellite decoder boxes or extensive coaxial cabling.

**We are really excited about the development of Global Invacom's new prototype for viewing satellite television. The demonstration system shows how the innovative distribution technology has the potential to change the way we view television around the home.**

Nader Alagha  
ESA telecommunications  
systems engineer



## → MANAGING NATURAL RESOURCES THROUGH SATCOMS

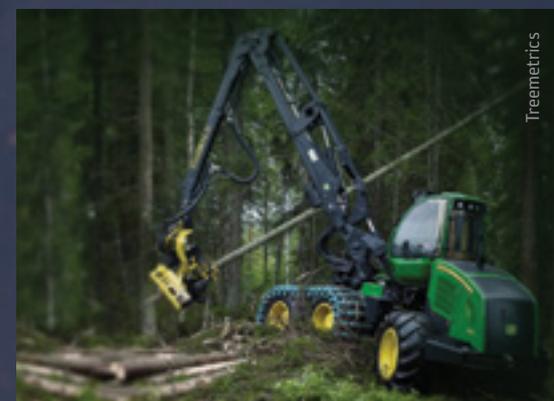
Treemetrics  
Ireland

Careful management and sustainable exploitation of natural resources, such as forests, is important for our collective future. Previously, the availability of realtime data on timber harvesting was limited, as the ability to send the data from harvesting vehicles in remote locations was hampered by the lack of reliable data transmission. The ARTES Satmodo project addressed this issue by using both satellite and terrestrial wireless transmission to relay live harvest data.

As a result, logging machines can be monitored in real time or near-real time. This significantly improves the

overall efficiency of the harvesting process. A communications device is installed in each logging vehicle, allowing individual machines or groups of machines to be monitored remotely.

By providing an easy-to-use management system, Satmodo delivers a tool capable of managing all of the steps in the production process. The pilot demonstrated that the value of the timber harvest can be increased by 20% using the new system. Furthermore, it delivered up to 30% savings across the entire timber management process by vastly



improving planning and contractor management. As such, the system was of real commercial value to the partners in the trial.

## → NEW PRODUCTS SECURE A SATELLITE CONTRACT

Airbus Defence and Space  
Germany

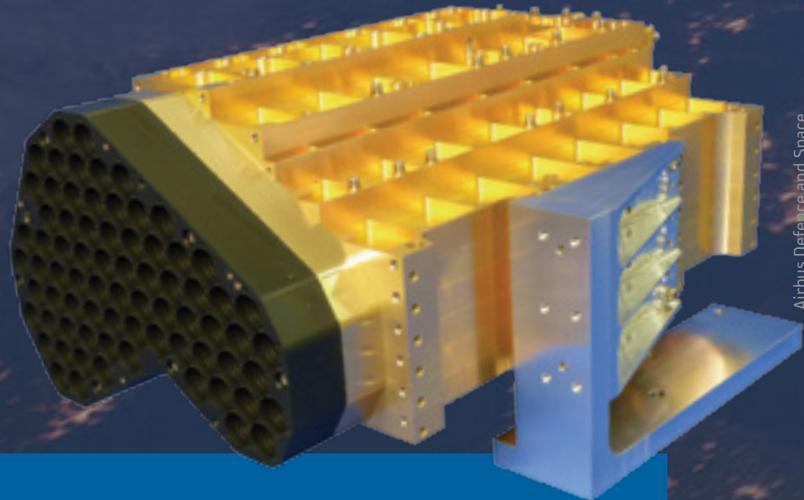
Airbus Defence and Space Germany have developed a new space antenna system that markedly reduces the number of large and costly reflector-type antennas required for satellite communications. This has not only introduced an innovative, cost-saving technology to the market but the new system also gave Airbus Defence and Space a critical edge over the competition, enabling the contract award for the design, manufacture and testing of the Express-AMU1 satellite for the Russian operator RSCC.

Developed within ARTES 3-4, the new Medusa system requires only half the number of reflector antennas compared to conventional designs. While Medusa is designed initially for the widely used Ka-band range, it can be deployed for other frequencies.

The reduction in the number of antennas means that antenna farms can be carried on a large platform alongside other missions. This makes it possible for manufacturers of small platforms to enter the multiple-spot beam market.

Express-AMU1 will also feature the first use on the Eurostar platform of the 100 V power subsystem developed as part of Alphas.

Medusa provides a good illustration of how European satcom companies, such as Airbus Defence and Space, are working with ESA to develop commercially attractive solutions to give them a competitive advantage and enable them to win export contracts for complete satellites in the strongly competitive global market.



Airbus Defence and Space



**ARTES is key to the competitiveness of the European communications satellite industry and its commercial success worldwide. The contribution of the ARTES 3-4 and 5.2 lines are of utmost importance for Airbus Defence and Space to foster innovation for our core products and technologies, continuously to introduce leading edge products capable of developing and maintaining our current position as market leader in geo comsats as a reference and dependable contractor for leading commercial operators.**

Arnaud de Rosnay  
Head of Telecommunications Satellites  
Airbus Defence and Space Germany



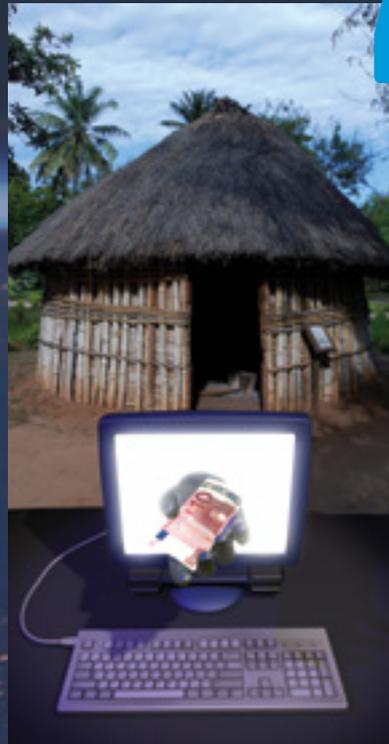
## → BANKING BY SATELLITE IN AFRICA

SatADSL  
Belgium

For the majority of people living in sub-Saharan Africa, modern banking services are practically non-existent. However, satellite communications are now making it possible to transfer money between remote locations in African countries that lack conventional telecoms services.

An ESA project looking at ways to use satellites to provide services in developing nations where land networks are simply impossible or non-existent gave rise to the Agency's SatFinAfrica pilot project in 2011 led by Sea&Space Exploration. This was so successful that Sea&Space spun off a company called SatADSL in Belgium in 2012 to provide low-cost satcoms-based IP access to African businesses, including financial services.

Microfinance offices in different villages, linked via satellite, allow people to transfer or withdraw money with ease. The service is sold via local African distributors who resell it to the microfinance offices in partnership with SatADSL.



Currently, SatADSL serves more than 150 offices and the number is growing. Each branch has its own satellite terminal. SatADSL received €1 million in 2013 from a leading

Sea&Space Exploration is extremely happy to have partnered ESA in this R&D activity that resulted in the creation of a commercial operating company.

SatADSL is exploiting European technologies for the benefit of African people, and supporting the development of financial services outside densely populated urban areas.

Caroline De Vos  
Chief Operations Officer of SatADSL

Belgian private equity investor to support this growth, with the aim of connecting thousands of branch offices of microfinance companies in sub-Saharan Africa via satellite.

## → FASTER TESTING OF SATELLITE PAYLOADS

Thales Alenia Space  
France

Satellite equipment needs to be rigorously tested before being launched into space. In particular, all payloads going into space must be carefully tested for electromagnetic compatibility (EMC) to ensure that they do not generate radio-frequency signals that might interfere with the operation of the satellite.

With ESA's support, Thales Alenia Space (TAS) set out to develop and industrialise an efficient EMC test method for telecom satellite modules. The result is a mobile, flexible conductive tent that can be placed over the entire payload. Special equipment performs automatic detection of radio-frequency leakage in

the communication bands of interest, using reverberation chamber methods.

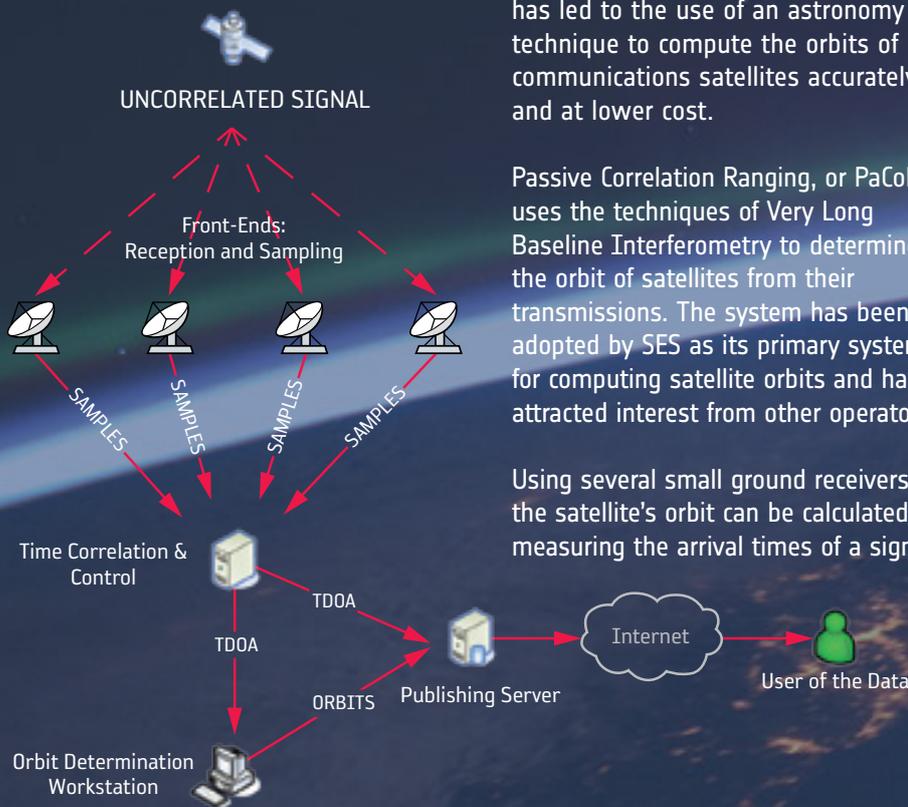
The new technique can test a variety of complex telecom payloads, reducing testing time during integration and verification. It also results in improved safety and security for equipment and technicians because it drastically reduces the need for someone to perform testing inside or close to the payload module.

For highly complex payloads, the saving in time could be up to several weeks. As a result, payloads can be delivered sooner, improving the overall satellite delivery schedule and resulting in substantial savings. The



system is expected to become a standard TAS way to test EMC. It has already been used to test the AT1, AT2, Yamal-401, Athena-Fidus and W3D satellite payloads.

## → ASTRONOMY TEACHES SATELLITES NEW TRICKS



A project supported by ARTES 3–4 has led to the use of an astronomy technique to compute the orbits of communications satellites accurately and at lower cost.

Passive Correlation Ranging, or PaCoRa, uses the techniques of Very Long Baseline Interferometry to determine the orbit of satellites from their transmissions. The system has been adopted by SES as its primary system for computing satellite orbits and has attracted interest from other operators.

Using several small ground receivers, the satellite's orbit can be calculated by measuring the arrival times of a signal

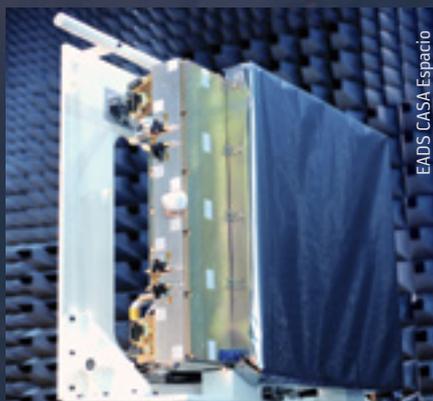
at different stations. The calculations can be made using any type of signal the satellite is transmitting, such as a broadcast television channel.

Using this simple passive system, the satellite's orbital position can be determined very accurately. This is particularly useful for satellite operators because it can be used to reduce problems caused by interference and allow satellites to be positioned closer together. These benefits improve transmission quality and enable a wider range of satellite services to be delivered.

The new system is strictly passive, so it does not require large and expensive ground stations or special signals to be transmitted from the ground to the satellite, and the same set of stations can be used to track multiple satellites, significantly reducing operating costs.

SES TechCom

## → MORE ROBUST SATELLITE RECEPTION



EADS CASA Espacio

Airbus Group – EADS CASA Espacio  
Spain

A growing issue in the world of broadcast satellites is interference between different systems, which may degrade the quality of the signal or even make the received data unusable. This interference is usually unintentional, but sometimes it is due to deliberate jamming. This makes it desirable to have the ability to restrict the geographical area from where a satellite receives its signals.

To make this possible, EADS CASA Espacio (part of Airbus Defence and Space, previously known as EADS), within ARTES, has developed an electronically steerable antenna called ELSA. In a Direct Radiating Array (DRA), a cluster of small antennas works together to form a larger one. By controlling the relationship of the signal between the different elements, it is possible to focus on specific geographical areas, while isolated from others.

Using DRA-ELSA, target areas can be configured and modified by ground control even when the satellite is already in orbit. This ability means the antenna will be more robust by rejecting intentional or unintentional interference. It can also be focused on a specific geographical area of interest when the need arises, such as new coverage, armed conflicts, natural

disasters and special events. This gives the operator great flexibility in coping with changes in market demands throughout the lifetime of the satellite.

DRA-ELSA, which will be flown on Hispasat's AG1 satellite, can receive Ku-band information simultaneously from four independent regions on the ground.

With a 65 x 65 cm radiating surface area, the DRA-ELSA Ku-band antenna will be the first of a number of developments in Europe aiming to provide commercial operators with extra capacity and greatly improved flexibility with their payloads, allowing them to keep their fleet of satellites operational for longer periods.

The new antenna technology is generating significant interest from commercial operators.

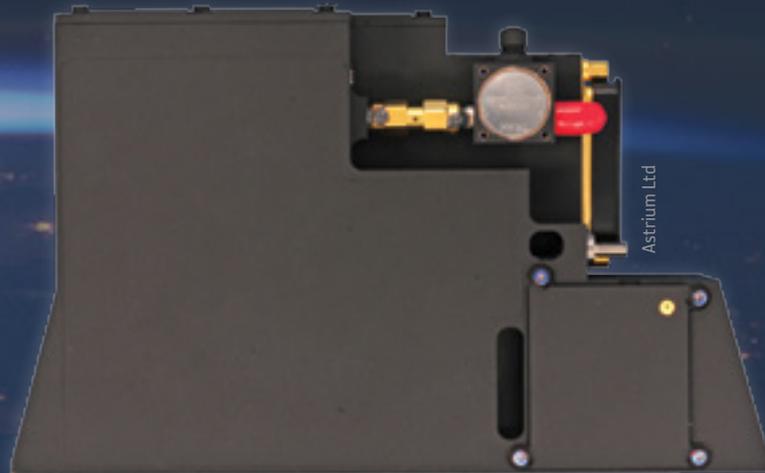
## → CONTINUOUS SUPPORT FOR R&D DELIVERS RESULTS

Airbus Defence and Space  
UK

Helping to move promising satcom technology from the laboratory to the marketplace has been one of the ARTES programme's greatest successes. Through ARTES, ESA boosts European industry's competitive position, delivering jobs and prosperity.

Under ARTES 4, Airbus began developing Modular Microwave Hybrid Technology (MMHT) in 2004. The aim was to develop a range of frequency converter products for the commercial telecommunications market. In addition, a new type of equipment was developed, an Agile Integrated Downconverter Assembly (AIDA), to validate the technology and confirm its suitability for space applications.

Building upon the positive outcome of MMHT, Airbus began a follow-on Generic Flexible Payload (GFP) project under ARTES 3 to further develop and qualify the technology. These developments paved the way for a number of future flexible payload designs and payload products. Some of these products are already in commercial use on satellites such as Hylas-1, which was developed through ARTES as a public-private partnership. Together, these products



provide a unique flexible payload solution, which continues to attract commercial interest.

The technology developed under MMHT and GFP also laid the groundwork for the company to extend its payload range significantly. A complementary beacon product line was developed, building on the results of MMHT. This extension to the product portfolio was supported by two additional ARTES 3-4 activities, one to develop C- and Ku-band single-frequency beacons and a second to develop a Ku-band dual-frequency beacon. Now the frequency

converter product line is being further extended under ARTES 3-4 to include downconverter assemblies for Ka-band multibeam applications.

Collectively, these ARTES 3-4 and ARTES public-private partnership activities have enabled Airbus to offer a wide range of competitive payload products on the mainstream telecommunications payload equipment market. Thanks to ARTES support, Airbus has entered this market for the first time and has already secured flight orders for more than 100 units, as well as frame contracts to supply future units.

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**Thanks to the continuous support of ARTES and the flight heritage gained through the Hylas-1 public-private partnership, Airbus has been able to secure significant new business in the highly competitive commercial market for telecom payload products and establish a solid foundation for future growth.**

Dr Peter L. Aspden  
UK Marketing Manager  
Telecommunication Satellites Division, Airbus Defence and Space

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## → A NEW APPROACH FOR TESTING LARGE SATELLITE ANTENNAS

Airbus Defence and Space  
Germany

Measuring the performance of an antenna designed to work 36 000 km from Earth, while it is still firmly on the ground, is a complex, expensive and time-consuming process. However, this could all be about to change as a result of some out-of-the-box thinking from Airbus Defence and Space in Germany and funding support from ARTES 3–4.

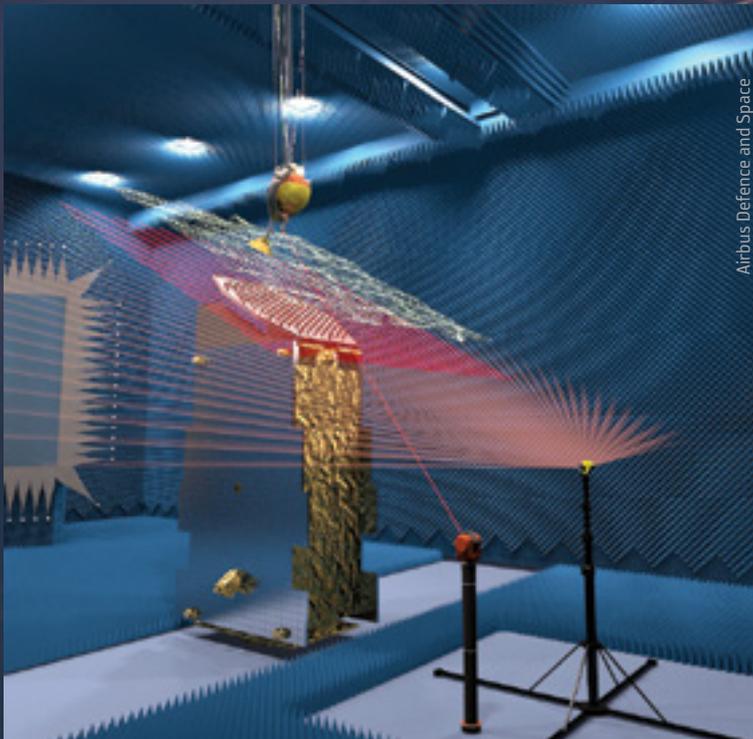
Early satellite construction required an antenna to be moved to an open field in order to measure its performance. As technology advanced, it became possible to carry out performance testing indoors using special dedicated near-field antenna facilities. However, such specialised facilities involved cumbersome measurement systems, and are expensive to build,

maintain and operate. In addition they require that the satellite be transported to the facility, creating additional costs and risks.

To overcome these problems, a portable system has been developed that enables the antenna to be tested without removing it from the cleanroom in which it was built. This Portable Antenna Measurement System, known as PAMS, places the measurement system inside a gondola that is then suspended from existing cranes within the assembly hall.

The system uses a commercial off-the-shelf laser tracker for precise localisation of the gondola and achieves levels of accuracy similar to that of the traditional system. The gondola supports testing at multiple frequencies, offering a high level of flexibility for aerospace and satcom applications.

In its final validation phase, the system has generated interest from potential customers across a range of sectors through the significant reductions in cost, risk and test time it offers. These improvements in measuring the performance of large antennas could provide users with significant commercial advantage in the competitive world of satellite manufacturing and testing.



Airbus Defence and Space

## → HIGH-POWER SUPER-Q KA-BAND OUTPUT MULTIPLEXER

Com Dev International  
Canada

The growing popularity of high-definition TV (HDTV) along with the desire for smaller satellite dishes is driving the need for more efficient transmission of radio-frequency (RF) power from space. This is leading to a substantial increase in the RF power managed by the output section of the satellite.

To address the issues associated with high RF power, new technologies need to be developed. For example, the output multiplexer (OMUX), which combines many TV channels for transmission to the ground, has severe power handling challenges.

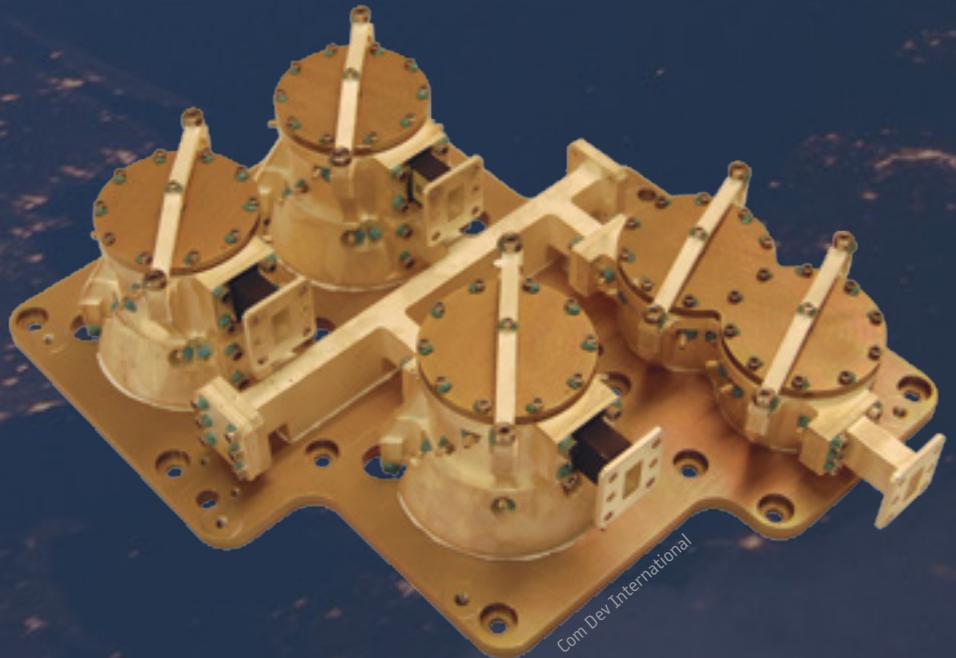
Thanks to an ESA ARTES 5.1 technology development contract, Com Dev has engineered a 500 W per channel Ka-band OMUX, with performance previously unheard of at these frequencies. The multiplexer features novel (patented) Super-Q resonators,

increasing the RF power-handling capability and dramatically reducing the RF losses in the multiplexer. This new multiplexer design represents a key enabling technology for future HDTV and other applications.

The development paves the way for additional sales of Ka-band filters and multiplexers to many customers, both within Canada and globally. Operators such as DirecTV and Echostar are already preparing next-generation

HDTV and broadband services that will require this type of multiplexer.

Com Dev is excited about the possibilities created by the development of the Super-Q resonator. In addition to the excellent performance of this technology for Ka-band output multiplexers, Com Dev is leveraging the development to extend the technology to higher frequencies and to input multiplexer applications.



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**ESA's ARTES has been instrumental in enabling Com Dev to successfully bring world leading products to the global space market.**

Michael Pley  
CEO, Com Dev International

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## → NAVIGATING THE ORBITAL HIGHWAY

Surrey Satellite Technology Ltd  
UK

Low-orbiting satellites, like many car drivers, have come to depend on GPS to determine their position and speed. Now, thanks to recent experimental work carried out with the retired Giove-A satellite, this may also become true of satellites in higher orbits, possibly as far away as the Moon.

The challenge has been that GPS signals are aimed at Earth. This is not a concern for low satellites operating below the height of GPS satellites. However, those above this orbit can see only GPS satellites on the far

side of Earth, and so the signals are much weaker.

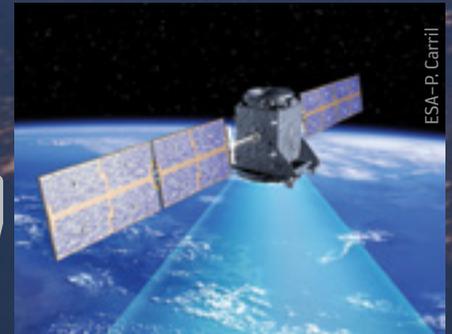
With support from ESA via ARTES, Surrey Satellite Technology flew a modified GPS receiver on Giove-A. Using this receiver, it acquired navigation signals and measured precisely the available signal strength from GPS satellites for high-altitude users, correctly determining its position and velocity for the first time. This exciting development opens up new capabilities for commercial communications satellites.

This will become particularly important with the advent of electric propulsion, with its many months of transition time between launch and a satellite reaching its final orbital position. The ability of the satellite to guide itself may significantly simplify this phase of its life.

These systems are also of interest for non-telecom missions, such as next-generation Meteosat satellites for weather forecasting.

**We have been really encouraged by the initial results from our receiver that were obtained in the frame of the ESA ARTES programme. Our patience has finally been rewarded, and we would like to make the best of this unique opportunity.**

Dr Martin Unwin  
Principal Engineer, Surrey Satellite Technology Ltd



## → FLEXIBLE PAYLOADS FOR FAST-MOVING MARKETS

Thales Alenia Space  
Italy

To maintain competitiveness, satellite operators must introduce new services to their customers and be adaptable to allocate capacity within the service area following the market demand throughout the whole operational lifetime of satellites. The satcom market is evolving quickly and satellites must be increasingly flexible to meet the needs of a changing landscape. However, this requires new and more complex payloads.

To address these issues, Thales Alenia Space Italia, assisted by ESA through ARTES, has embarked on the development and qualification of four critical new products that provide agility and flexibility for bandwidth management and form the core of a flexible payload.

These new products include a modular Agile Frequency Converter, combined with a centralised Frequency Generator Unit, which allows the payload to use complex conversion schemes over a wide range of frequency bands. Overall payload routing is provided by an Integrated Microwave Switch Matrix, which allows channel allocation and combination flexibility.

The fourth unit, developed under the contract with ESA, was the Agile Command Receiver, which allows the operators to set (and modify while in orbit, if necessary) the frequency for telecommands within the entire Ku-band range, rather than at a specific frequency as has historically been the case.



These new products have already found commercial success, with more than 30 units already delivered, including for Israel's Amos-4 and Amos-6 satellites.

## → LOWERING THE COSTS OF SATCOMS PROCUREMENT

YellowSat  
France



The costs associated with procuring capacity represent a large part of overall satellite communication satcom costs. This is often perceived as a barrier to potential customers, particularly small businesses or people in remote areas and developing countries.

The ARTES Smart project undertook the development and demonstration of a low-cost satellite access provision service with YellowSat, on a geosynchronous satellite in an inclined orbit. The goal was to sell an integrated package directly to operators that included low-cost tracking terminals, centralised realtime monitoring and control tools, plus satellite bandwidth.

Smart provided centralised monitoring tools and automated recovery mechanisms in order to handle automatic repointing and tracking to back up satellites efficiently, in inclined or non-inclined orbits, as well as managing networks composed of multiple user terminals. YellowSat is operating two stations in Somalia, three in Congo and is planning to deploy another eight for a star network in Uganda.

The results of Smart have proven the viability of a one-stop shop to deliver low-cost satellite services.

## → KEEPING A COMPETITIVE EDGE

Kongsberg Norspace  
Norway

The telemetry, tracking and control (TT&C) subsystem is the heart of a satellite, allowing communication between space and ground control systems. Remaining competitive in the market for these key components is a crucial challenge for Europe's space industry.

With the support of an ARTES 3-4 contract from ESA, Kongsberg Norspace developed a new TT&C subsystem. This was a diversification for the company, away from their heritage as

a payload equipment supplier, representing a new product line.

These units have been fully tested in space and now form a mature and competitive set of products, with commercial orders including export orders from outside Europe. More than 40 units have been delivered since the product's introduction, giving the company a 10% share in this highly competitive market.

Eighteen units are in orbit and the first units have more than three years of flight heritage.

This has been a strategic success for Kongsberg, demonstrating how a well-established European space company can continue to innovate and establish itself as a key supplier in new product lines with the assistance of ARTES.





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